a great aid, and it seems certain that, with the increased accuracy that is bound to come, they will ultimately constitute the most valuable feature of the weather service. There is some question as to most suitable period of time to include in the forecasts. Naturally the shorter the period, the more precise the forecasts; but, on the other hand, their value is limited unless they cover at least a reasonable period. As a basis for compromise, the maximum length of the great majority of flights has been chosen—that is, three to four hours.

As earlier stated, the basic material for all forecasting is the country-wide, twice-daily collection of reports which are used in constructing the well-known weather maps. The forecasts for 12 to 24 hours, based on these reports, are quite dependable but are necessarily given in general terms. What is needed is their amplification and localization. For this purpose supplementary reports from relatively small areas are required, small at any rate as compared with the country-wide, twice-daily system.

As an experiment, the period of three hours has been selected, the observations being made at 2, 5, 8, and 11 a. m. and p. m., seventy-fifth meridian time. About 110 stations are at present in this system. They transmit their reports to airways-forecast centers at Atlanta, Ga.; Cleveland, Ohio; Dallas, Tex.; Fort Crook (near Omaha), Nebr.; Oakland, Calif.; Portland, Oreg.; and Salt Lake City, Utah. The data are entered in detail on base maps, and lines of equal pressure are drawn. The maps for 8 a. m. and p. m., seventy-fifth meridian time, being based on the bureau's primary system of reports, are, of course, much more complete than are the six others. The latter are used as auxiliary to the former and serve to show the changes taking place in the areas for which the short-range forcasts are issued.

Although designed primarily for flying activities over established airways, the 3-hour system of reports and forecasts in large part also solves the problem of so-called off-airways flights. Before the organization of this system there was no provision for obtaining special reports from places not on regular routes except by special call and at the expense of the pilots desiring them. Now, however, information is fairly complete for large areas, and anyone desiring reports for cross-country flights in those areas has only to listen in at the proper times, since these summaries are regularly broadcast, as well as the hourly reports of conditions along the established airways themselves.

Thus far the need and value of short-range forecasts have been stressed. They are relatively precise and cover approximately the duration of nearly all flights. But they will never do away with the necessity of the longer-period forecasts, to which, rather, are they supplementary. The 12 to 24 hour forecasts will become increasingly important. While the individual pilot is interested in the weather for a few hours, the operations manager of an air-transport line needs to make his plans as far in advance as possible. Particularly is this true if passenger service is included.

Thus, the three main features of weather service for aeronautics are each essential to the proper functioning of the others: (1) The frequent, individual reports tell of the weather now; (2) the short-range forecasts cover the individual flights or announce the weather that is soon to be; and (3) the basic general forecasts indicate the likelihood of successful flying to-morrow. Considered in reverse order, the general forecasts form the groundwork of the entire service; they are supplemented by the more intensive shorter-period forecasts; and both of these are still further supplemented by timely reports of current conditions, which check the forecasts previously made and provide data for slight modification in them, if necessary.

Again referring to the chart, the system of airways there shown is only a beginning. Already surveys are being made by the Department of Commerce for many additional lines, and eventually the entire country will be covered. As rapidly as these airways are established the Weather Bureau, to the extent that additional appropriations permit, will organize service for them, along the lines of the present service, with such modifications in details as experience may show to be desirable. Fortunately, the cost of these extensions will be considerably less per airway mile than that of the service thus far organized, since much of the latter will give information that will meet in part the needs of the new lines.

THE GREAT DROUGHT OF 1930 IN THE UNITED STATES—SUPPLEMENTAL NOTES

The previous paper on this subject (this REVIEW, September, 1930) was more or less incomplete owing to the uncertainty as to the end of the drought and the difficulty of quickly getting information from the field as to the progress of the drought in all sections. Several odds and ends have come to hand since the first account was printed. These will now be given:

THE DROUGHT EXTENDS TO THE PANAMA CANAL ZONE

Mr. R. Z. Kirkpatrick, chief of surveys, Canal Zone, supplies us with the data given in the table below showing conclusively that drought was felt almost to the Equator. The shortage of water yield was at a maximum in February and reached a second maximum in August.

TABLE 1.—*Departure from the normal water yield, Chagres River and Lake Gatun, Panama Canal Zone, January–September, 1930*

Month	Chagres River		Net yield Gatun Lake watershed	
	Above	Below	Above	Below
	Per cent	*Per cent*	*Per cent*	*Per cent*
January		44		39
February		45		48
March		34		47
April		3	1	
May		1	1	
June		20		38
July		18		26
August		40		39
September		15		26

—*A. J. Henry.*

THE INFLUENCE OF TREES AND ASSOCIATED UNDERGROWTH ON THE RATE OF STREAM DISCHARGE

Because of the prolonged and almost continuous drought of the past five months many wells in near-by Maryland and Virginia communities have registered gradually falling levels of water, and several have gone dry. Springs that in any average summer season flow constantly have during the past summer ceased to flow or have flowed only more or less intermittently. The season has been an unusually favorable one for making observations on the rate of water discharge of springs and small streams and the relation of trees and other immediate vegetation to such discharge.

So far as the writer has been able to ascertain there has been published but little in the nature of like observations. One important paper, however, deserves mention, in which Bates and Henry [1] published the results of an experiment at Wagon Wheel Gap, Colo., begun in 1909 and completed 15 years later. In their study of the data recorded during this experiment they found, among other facts, that the evaporation induced by warm summer weather, combined with the water requirement of immediate plant growth, caused a rapid withdrawal of water from the surface soil. This condition they found to continue until the period of maximum heat had passed and decrease of vegetative vigor had set in.

More recently, Purton [2] has observed a marked diurnal fluctuation in the flow of a small stream near Hawthorne, Nev. Inasmuch as the rate of discharge began to decline at sunrise and before there was any marked rise in atmospheric temperature, he assumed that the fluctuation was due chiefly to transpiration of the vegetation, chiefly willows, along the stream.

During the period September 15 to October 12, inclusive, daily observations were carried on by H. B. Humphrey at his home in Cabin John, Md., on the rate of stream discharge. Lacking standard meteorologic equipment he was obliged to accept, with allowance for certain more or less constant differences in temperature and relative humidity between Washington and Cabin John, the weather records for the former station. The temperature readings taken simultaneously at the two points during the first week of October, for example, showed consecutive daily minimums of 46°, 45°, 44°, 52°, 43°, 42°, and 44°, whereas, at Cabin John, the corresponding minimum temperatures were consistently lower. Killing frosts occurred on the 5th and 6th, and these unquestionably inhibited to a marked degree the respiration activities of the trees and other vegetation in the neighborhood.

In a deep and narrow ravine, just west of his residence, runs a little stream fed by some springs at the head of the ravine. This stream flows into a small reservoir and thus furnishes water for the operation of a hydraulic ram. The distance covered by the streamlet is approximately 200 feet, and within that distance and the confines of the ravine are 32 trees of various heights, sizes, and species. The smallest of these measure 3 inches in diameter and the largest, 30 inches. In addition to the trees is a limited growth of shrubby plants such as spice bush, pawpaw, and red bud, and saplings of such tree species as beech, hickory, dogwood, oak, and maple. The stream was so well covered by low vegetation that the water loss through evaporation probably was relatively negligible.

The first observation was recorded on September 12, when it was noticed at 6 p. m. there was no water discharging from the stream into the reservoir. The following morning, at 7 o'clock, water was flowing into the reservoir at the rate of nearly 5 quarts per minute. In the late afternoon of September 13 there was a thundershower and a consequent precipitation of 1 inch of rain at Cabin John. At 12 o'clock, noon, on the 14th, the rate of stream discharge was 4 quarts per minute; at 4 p. m. it was 1.9 quarts per minute. Thereafter (Table 1) the readings were made daily at 7 a. m. and, except on September 16, at 6:15 p. m., for a total of 28 days, during which period there was no further precipitation. At 6:15 p. m. on the 16th it was raining, and no reading was made.

A glance at the table will show that, in general, there was a gradual decline in the daily maximum discharge until September 30, when, apparently because of a sharp fall in temperature there was an increase in the rate of discharge from 4.40 to 6 quarts per minute. There also was a corresponding decline in the evening readings until September 23, by which time the evening discharge of the little stream had ceased. It did not resume until the evening of October 3, or three days after the abrupt and continued drop in temperature. The evening readings showed an increasing discharge until October 9, when again there was an apparent response to rising temperature. This response was not, however, apparent in the morning readings until the morning of October 10. Although it was impossible to control any of the several possible variables, it seems probable that the rate of discharge by the end of the day was influenced by temperature and sunshine. This relationship is indicated by the stream's evening performance from October 2 to 12, during which time the minimum rate of discharge rose from 0.0 quarts per minute on October 2 to 3.00 quarts per minute on October 8 and then declined through 2.40, 1.76, and 1.20 to 1.10 quarts per minute on October 12. The maximum evening discharge, namely, 3.00 quarts per minute, occurred on the 8th. On that day there was a total of but 23 per cent of sunshine. On the following day there was a total of 29 per cent. Thereafter, the per centage of sunshine rose to 77 per cent on the 10th and to 100 per cent on the 11th and 12th.

TABLE 1.—*Daily maximum and minimum rate of water discharge of stream at Bryn o Dderw, Cabin John, Md., for the 28-day period, September 15 to October 12, 1930*

[The temperature, relative-humidity, and sunshine data were recorded by the Weather Bureau at Washington, D. C.]

Day	Quarts per minute		Temperature		Relative humidity			Sunshine
	7.00 a. m.	6.15 p. m.	Maximum	Minimum	8 a. m.	Noon	8 p. m.	
					Per cent	*Per cent*	*Per cent*	*Per cent*
Sept. 15	6.00	1.30	97	71	93	52	53	84
Sept. 16	5.00	(1)	95	72	73	49	87	69
Sept. 17	7.50	3.40	88	70	81	43	41	78
Sept. 18	5.20	2.40	78	61	53	32	58	63
Sept. 19	5.00	1.90	82	59	71	32	61	50
Sept. 20	5.00	1.50	84	61	83	47	58	72
Sept. 21	5.00	1.05	88	68	87	43	60	64
Sept. 22	5.00	0.0	93	66	67	37	46	89
Sept. 23	5.00	0.0	90	70	65	37	48	79
Sept. 24	4.80	0.0	92	66	80	61	71	67
Sept. 25	4.78	0.0	95	73	80	45	64	59
Sept. 26	4.78	0.0	96	70	77	44	51	100
Sept. 27	4.75	0.0	81	58	44	24	31	78
Sept. 28	4.78	0.0	81	52	70	28	43	100
Sept. 29	4.60	0.0	75	53	50	26	38	76
Sept. 30	4.40	0.0	71	52	56	38	38	88
Oct. 1	5.40	0.0	64	46	70	40	49	93
Oct. 2	5.40	0.0	68	45	66	36	53	100
Oct. 3	5.45	1.30	69	44	69	40	54	79
Oct. 4	6.00	1.00	67	52	63	33	36	87
Oct. 5	5.40	1.50	67	43	54	32	34	85
Oct. 6	5.40	1.80	75	42	71	33	56	97
Oct. 7	5.70	1.80	78	44	80	31	46	83
Oct. 8	5.70	3.00	70	58	84	50	59	23
Oct. 9	5.70	2.40	72	59	84	61	69	29
Oct. 10	5.70	1.76	78	55	91	57	72	77
Oct. 11	5.40	1.20	77	54	81	47	61	100
Oct. 12	5.00	1.10	77	53	87	47	60	100

[1] Rain, 0.33 inch.

[1] Bates, C. G., and A. J. Henry. Forest and stream-flow experiment at Wagon Wheel Gap, Colo. MONTHLY WEATHER REVIEW, Suppl. No. 30, U. S. Dept. Agr. Weather Bureau. 1928.

[2] Transpiration affects stream flow. Engineering News-Record, Vol. 105, No. 17, p. 662. Oct. 23, 1930.

The temperature for the period October 6 to 12 remained relatively uniformly high; and the fact that there was this sudden increase in discharge at the end of the day would seem to indicate an important relationship between sunlight and stream discharge, at least so in this particular instance.

There is no apparent correspondence between mean relative humidity from day to day and daily fluctuations in the rate of discharge of the little stream under observation, though it is conceivable that differences in this variable must have had their parallel differences in the loss of water from the leaf surface of the trees and other vegetation through evaporation.

Until the 1st of October the 32 trees and other vegetation in the ravine under observation were functionally very active, and their diurnal water requirement was consequently high, perhaps approximating the maximum, highest from sun to sun and sinking to a minimum during the night. To determine the total daily discharge of our little stream and, inversely, the approximate daily water consumption of the plants dependent on this source of supply, hourly readings were made from 7 p. m., September 27, to 7 a. m. September 29. (Table 2.) It will be seen that the trees and undergrowth exerted an ever-increasing "pull" on the supply from about 10 a. m. until late afternoon and that no water was running from just before 3 o'clock p. m. to a little after 7 o'clock. The theoretical total discharge for the 36-hour period was 6,264 quarts. Since October 3 the stream has not ceased to flow at all hours of the day and night, and now that the vegetation has either died or entered upon its period of winter rest, the hourly rate of discharge remains virtually constant at 6 quarts per minute.

TABLE 2.—*Hourly increase and decrease in rate of discharge of reservoir inlet at Bryn o Dderw, Cabin John, Md., from 7 p. m., September 27, to 7 a. m., September 29, 1930*

Hour	Discharge (quarts per minute)	Temperature ° F.[1]	Hour	Discharge (quarts per minute)	Temp ture[1]
7:00 p m	0.00	70	2:00 p. m	0.46	77
8:00 p. m	0.90	69	3:00 p. m	0.00	80
9:00 p. m	1.20	66	4:00 p. m	0.00	80
10:00 p. m	2.49	62	5:00 p. m	0.00	79
11:00 p. m	3.00	60	6:00 p. m	0.00	76
12:00 m	3.33	58	7:00 p m	0.00	72
1:00 a. m	3.75	57	8:00 p. m	1.00	71
2:00 a. m	3.94	55	9:00 p. m	2.00	71
3:00 a m	4.13	54	10:00 p. m	3.00	68
4:00 a. m	4.32	53	11:00 p. m	3.10	64
5:00 a. m	4.51	52	12:00 m	3.38	63
6:00 a. m	4.70	52	1:00 a. m	3.66	60
7:00 a. m	4.78	52	2.00 a. m	3.94	56
8:00 a. m	4.78	58	3:00 a. m	4.22	58
9:00 a. m	4.78	66	4:00 a. m	4.50	56
10:00 a. m	4.28	72	5:00 a. m	4.60	54
11:00 a. m	3.24	74	6:00 a. m	4.60	54
12:00 n	2.20	75	7:00 a. m	4.60	53
1:00 p. m	1.15	77			

[1] Washington, D. C., temperature at Weather Bureau Observatory Twenty-fourth and M Streets NW.

Total discharge, 6,264 quarts.
Total 24-hour discharge 8,352 pounds.
Total possible 24-hour discharge, 13,766 pounds.
Total taken by vegetation, 5,414 pounds.

According to Table 2, the maximum rate of discharge obtained between 7 and 9 o'clock a. m. But, since after leaf fall and prior to any possible augmentation from rainfall, the discharge increased to the rate of 6 quarts per minute, the difference between this maximum and that recorded on the 28th of September, i. e., 1.22 quarts per minute, may be assumed to represent approximately the index to the minimum respiration requirement of the trees and undergrowth. We may therefore safely assume that had there been no vegetation tributary to this water supply the rate of discharge during the 36-hour period recorded in Table 2 would have been approximately 6 quarts per minute. The total discharge would then have amounted to 12,960 quarts. The difference, 6,696, between 12,960 and 6,264, the recorded total discharge of the stream during the 36-hour period, should therefore roughly represent the number of quarts of the water consumed by the vegetation. This, converted to weight units, becomes 13,392 pounds, or 6.7 tons.

At present writing, November 20, the precipitation at Washington since November 1 has been exactly 0.50 inch. That for Cabin John has been even less. It is therefore probable that very little, if any, water has been added to the daily discharge of the little stream here under consideration. It is now discharging at the almost hourly constant rate of 6 quarts per minute, or 360 quarts per hour, or at the same rate recorded on November 1. It should here be observed also that with the advent of the cool October days and cooler November, together with the almost complete cessation of all plant growth demands on the soil moisture, the level of Cabin John Run at Aqueduct Bridge is now between 6 and 7 inches higher than it was 60 days ago.—*Harry B. Humphrey.*

STREAM-FLOW RETURNS BEFORE THE RAINS COME [1]

"The return of the flow of water in the streams of Fairfax County, Va. (near Washington, D. C.), before the occurrence of rain became noticeable with the coloring of the leaves in early October, and was well marked after the time of killing frosts, October 21, 22, and 23. The upper portion of Pimmett Run, a branch of the Potomac, ceased to flow as a continuous stream August 9, although there were pools here and there fed by springs. No one can establish that it ever ceased to run before. Its flow began again toward the end of October. Small springs here and there kept a continuous discharge throughout the entire period, but the water made but little progress down the course of the stream. The only water in Burke Spring Run, a branch of Pimmett Run, came from a spring at the base of a hill used for farming purposes. This spring appears to have dwindled slightly throughout the period but was still active October 26. These streams are in a farm-land community, but trees and bushes grow close to them for the greater length of their course." The Fairfax Herald of November 7, 1930, carries the following:

> In spite of the fact there have been no rains to bring water back into streams in the county, it is reported that a considerable trickle of water has reappeared in Difficult Run, and W. E. Kirby, residing about 2 miles north of Falls Church, states that water has returned to what is known as Burke Spring Run, that empties into Pimmett Run. For several weeks past Mr. Kirby has been watering his cows by carrying water to them from his pump, which has not failed him, but now he is able to water the cows at the run, much to his delight. Reports coming from the south side of the county, in the vicinity of Accotink, say that water has reappeared in streams in the vicinity of Camp Humphreys. J. L. Millan, residing on Chain Bridge Road, a short distance beyond Wiley station, reports that a spring on his place that has been dry for several weeks came to life a few days ago, and a good stream of water is flowing from it down to the bed of a small creek, which it fed.
>
> The Herald would like to hear from other sections of the county if water is reappearing in streams and springs.

—*B. C. Kadel.*

[1] The following note by Mr. Kadel shows that the phenomenon described by Doctor Humphrey was more or less general in Virginia just across the Potomac River from Cabin John, Md.—*Ed.*

THE PRECIPITATION IN CANADA

January.—The month was quite dry from the Pacific coast to the head of the Great Lakes, and also through northern Ontario into northern Quebec. In parts of southern Ontario the snowfall was unusually heavy and the same condition prevailed largely in western Quebec. In Prince Edward Island and part of southern Nova Scotia precipitation was considerably in excess while in New Brunswick it was generally less than normal.

February.—Precipitation was deficient in Alberta, southern Saskatchewan, southern and eastern Ontario, the St. Lawrence Valley and the Gulf regions, and parts of the Atlantic Provinces. There was an excess in British Columbia, the central portion of the grain belt in Saskatchewan, in Manitoba, northwestern Ontario, southern New Brunswick, Prince Edward Island, and a part of Nova Scotia, also in the far northern regions for the most part as yet unknown.

March.—Precipitation was considerably above the normal amount in the Yukon and the lower Mackenzie Valley, in parts of northern Ontario, along the lower St. Lawrence Valley and part of the Gulf region, and in parts of the Atlantic Provinces. There was a moderate excess in the counties north of Lake Erie and Ontario and in western and northern Manitoba, part of northeastern Saskatchewan, locally in Alberta, and locally in the interior of British Columbia.

There was a moderate deficiency in western and southwestern British Columbia except locally. There was a moderate deficiency in Alberta and Saskatchewan, as a whole, but a fairly large deficiency in northern Alberta and the extreme southern portions of both Alberta and Saskatchewan. A moderate deficiency occurred in the eastern portions of the Atlantic Provinces.

April.—Over most of Canada this was a dry April. In Ontario, Quebec, except the lower St. Lawrence Valley, the Atlantic Provinces, Manitoba, except the Dauphin district, eastern and northern Saskatchewan, part of northern Alberta, and in parts of British Columbia, precipitation was less than normal by 25 to 50 per cent for the most part.

In southern Alberta and southwestern Saskatchewan the month was much wetter than usual, two to four times the usual amount being recorded over a large area. In British Columbia excesses of 40 to 50 per cent of the normal amount were recorded in some places and deficiencies of 10 to 50 per cent in others. In the lower St. Lawrence Valley excesses were 10 to 50 per cent of the normal amount.

May.—During May precipitation over the Dominion occurred for the most part as passing showers with great variation in intensity in short distances. In most of Manitoba and part of eastern Saskatchewan the excess over the normal amount ranged from 40 to 180 per cent. In southwestern Quebec the excess ranged from 5 to 125 per cent. In Ontario there were some moderate deficiencies and some large excesses with a moderate excess generally. In the Atlantic Provinces and the Gulf region of Quebec, totals were generally below normal although northeastern Nova Scotia and a few other localities had an excess. In the Peace River country and part of the Edmonton region precipitation was either normal or considerably in excess.

June.—The remarkable feature of the month was the unprecedented rainfall in northern Ontario and northern Quebec. From 10 to 15 inches were reported from the vicinity of Lake Temiskaming and Lac des Quinze. Several times during the last 10 years there have been very wet months in northern Ontario with totals of 5 to 8 inches, but the previous highest total was 8½ inches, while the average rainfall for June during the last 35 years is a little in excess of 2¾ inches. * * * In southern Ontario the rainfall was about twice the normal amount in some localities while there were deficiencies in the region of Lake St. Clair and locally on the shore of Ontario.

Rainfall was deficient in Alberta by 10 to 40 per cent except in the Lloydminster-Vegreville area and the Peace River Valley where there was an excess. In Saskatchewan considerable areas in the north and south portions of the grain zone had excesses of about 35 per cent, while the central part of the zone had deficiencies of 10 to 50 per cent. In Manitoba rainfall was well above the normal in the central districts and moderately deficient elsewhere. In the Atlantic Provinces the month was very dry in Nova Scotia, Prince Edward Island, and parts of southern New Brunswick, while the northern New Brunswick there was an excess, with exceptionally heavy rain in some districts. In British Columbia the southern interior and Vancouver Island were considerably drier than usual while in the northern interior and on the northern coast the month was moderately wet.

July.—On the southern margin of the northeast cool front, frequent rainfalls occurred during July, totalling 4 to 8 inches in the wettest districts of northern Ontario and Quebec and parts of the Atlantic Provinces. The occasional excursions of cool air into the northwest were followed by good rains in parts of Manitoba, and northern sections of the wheat region of Alberta and Saskatchewan totalling 2 to 6 inches. In the far northwest and northeast two to three times the usual rainfall occurred. In the southern portions of the grain region, southwestern Ontario, and in British Columbia, except the north Pacific coast, very little rain fell.

August.—The month was generally drier than usual from the Pacific Ocean eastward to the Ottawa River. Over a large part of this area the deficiency was very great. In the Lake St. John and Saguenay region of Quebec, the Gaspe Peninsula and generally in New Brunswick except the extreme south, August was a month of frequent rains with the total rainfall exceeding the normal amount. In the Temiskaming region of northern Ontario rain was also heavy. In Nova Scotia there was generally a moderate deficiency.

September.—Less than the usual amount of precipitation was recorded in the Yukon and far northern British Columbia, but in the middle latitudes of British Columbia from Prince Rupert to the upper Fraser Valley and thence east to Yellowhead Pass and the Peace River Valley there was an excess over the normal amount of about 30 per cent in the interior and about 10 per cent on the coast.

In southern British Columbia, as well as in that part of Alberta lying between Edmonton and Calgary, precipitation was generally less than normal. In extreme southern Alberta, and in Saskatchewan, except the southeast, there was an excess of approximately 25 per cent, with locally quite heavy amounts in the Prince Albert-Saskatoon region. In southeastern Saskatchewan, southern Manitoba, southern Ontario, southwestern Quebec, and the greater part of the Atlantic Provinces, as well as the Abitibi slope and the Lake of the Woods region in northern Quebec, the total was less than normal. In southeastern Saskatchewan, southern Manitoba, and the Lake of the Woods region the deficiency was generally from one-third to one-half of the normal amount. In southern Ontario the deficiency varied from 10 to 60 per cent. In the Atlantic Provinces rainfall was generally from 20 to 90 per cent below the normal. In southern Quebec the deficiency was 20 to 60 per cent. Along the north shore of Lake Superior to Sudbury and Haileybury and also in the region of Lake St. John and locally in the upper valley of the St. Maurice as well as in the Gaspe Peninsula and parts of the north shore of the Gulf of St. Lawrence, showers were frequent with moderate excess over the normal. Norman, Smith, and Churchill, in the far north, reported excesses of 30 to 90 per cent of the normal, while Simpson, Aklavik, and Chesterfield reported deficiencies. Returns from the Coppermine were incomplete.

October.—Precipitation was generally well above normal from Lake Superior to the Pacific Ocean, except in the far northwest. From Lake Superior and the Abitibi River south and east to the Bay of Fundy, precipitation was generally deficient. In Nova Scotia there was an excess over the normal amount except immediately along the coasts of the Bay of Fundy.—(*Excerpted from the Monthly Weather Map of Canada for the several months, January to October, 1930.*)

From the foregoing it is evident that Canada, especially in June and July, was favored with a greater rainfall about the Hudson Bay region and parts of northern Ontario and northern Quebec, than was received below the border between Canada and the United States.

Daily pressure charts for the Northern Hemisphere make it clear why the precipitation in Canada was less scant than in the United States. During the first half of July, for example, several rather extensive areas of high pressure occupied the North Atlantic not far to the eastward of the Canadian Maritime Provinces; these

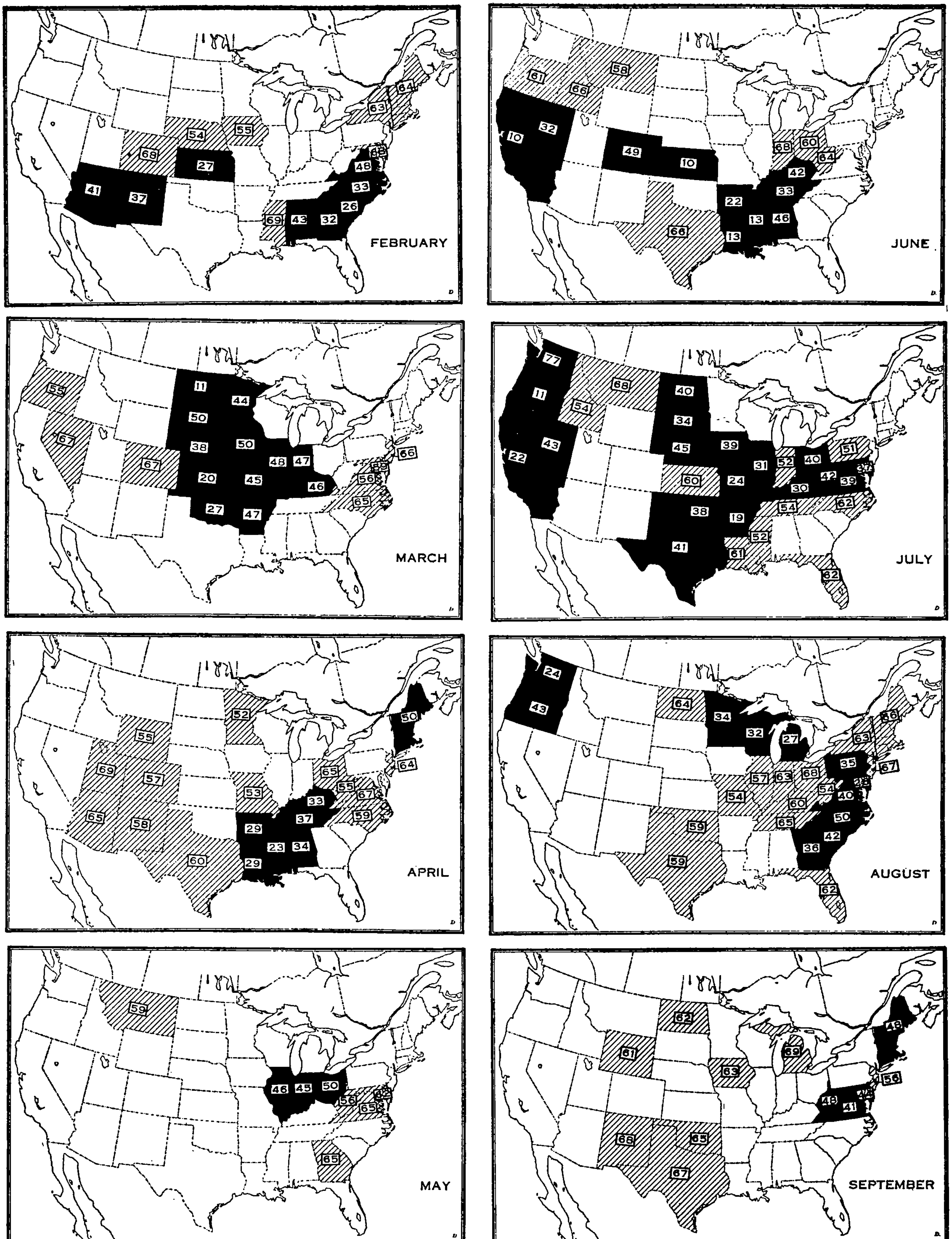

FIGURE 1.—*Per cent of normal precipitation February to September, 1930.* Full shading indicates less than 50 per cent of normal; slant shading shows between 51 and 69 per cent of normal or a near drought

formations doubtless were responsible for the abnormal course of cyclonic systems that otherwise would have moved in a more nearly normal direction; during the second half of the month the areas of high pressure over the western North Atlantic were found farther south with westward extensions over the continent of North America and as previously stated they were a distinct deterrent to precipitation over eastern United States. On July 31 an unbroken area of high pressure extended from the Spanish coast on the east across the Atlantic and the Continent and still farther west over the Pacific at least to the one hundred and seventieth meridian of west longitude, while the only low pressure on that date was along or near the Arctic Circle in both Europe and America and northeastern Asia. The full story of the drought will not be told until definitive data for the Northern Hemisphere are available. The course of the drought in the United States from month to month is portrayed graphically by the series of 9 small charts of Figure 1.—*A. J. Henry.*

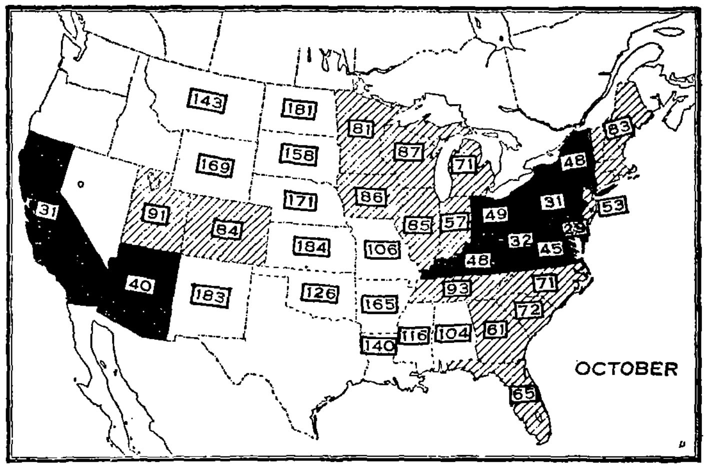

FIGURE 1A.—Per cent of normal precipitation. This chart shows the per cent of normal in all States from which reports have been received. Texas, Washington, Oregon, Nevada, and Idaho not yet available

DROUGHT IN OHIO VALLEY AND WATER SUPPLY

By W. C. DEVEREAUX

[United States Weather Bureau, Cincinnati, Ohio]

The general drought of 1930 in the Ohio Valley began in March or April, and continues at the end of November. The surface run-off practically stopped early in the summer, and the underground water supply diminished rapidly and by the middle of the summer the springs ceased flowing, the creeks and small rivers dried up, and wells failed. These conditions became more acute during August. In September there were fairly good rains over most sections of the valley which revived pastures and restored growing conditions, but there was no run-off to start stream flow or affect the municipal water supply.

The months of October and November (to the 25th) were the driest of the year, thus far, at Cincinnati and probably in most of the Ohio Valley. From 58 stations well distributed over the Ohio Valley and reporting daily to Cincinnati, the average rainfall for October was 1.30 inches and for November 1 to 25 it was 1.37 inches. These amounts are less than one-half of the normal amounts in both months for the area which includes Kentucky, Tennessee, West Virginia, the middle and southern portions of Indiana and Ohio, and extreme western Pennsylvania.

Not only the smaller rivers have been dry all summer, but many of the larger rivers are now dry where artificial pools have not been maintained. In the Kentucky River above Beattyville where the last dam is located there is only a "trickle" of water coming over the bed of the river. This river drains 1,654 square miles and is fed by mountain streams. The United States Engineers find the stream flow to be between 2 and 3 second-feet, estimated as it is impossible to measure it. The same is true of many other rivers in the Ohio Valley.

The municipal water supply has given out in practically all the cities and towns where the water was obtained from unimproved rivers, wells, or springs. At Lexington, Ky., water has been drawn by trainloads for several weeks from the pools in the Kentucky River. At present the construction of a pipe line to the river, a distance of about 25 miles, is being pushed so as to have service in the same by December 1. Even cities like Vanceburg on the Ohio River, but which have depended on wells for their water supply, are now constructing water-supply systems.

Fortunately the Federal Government had completed the 50 dams in the Ohio River before the great drought of 1930. These dams have maintained full pools from Pittsburgh, Pa., to Cairo, Ill., during the entire summer and fall. These dams have formed a series of 50 lakes averaging 10 or more feet deep, from 1,400 to 3,000 feet wide, and extending a distance of 1,000 miles. Many of the larger tributaries such as the Allegheny, Monongahela, Muskingum, Kanawha, Kentucky, etc., have been improved by dams. The water from the pools in these rivers has made it possible for life to exist and business to progress in the Ohio Valley during the driest season of record in the valley.

Principal Hydroelectric Engineer W. S. Winn, of the United States Engineer office, Cincinnati, Ohio, supplies some of the details of low water in Kentucky River and the illustrations presented in the note next below.

LOW WATER IN THE KENTUCKY RIVER, 1930

By W. S. WINN, Principal Hydroelectric Engineer, United States Engineer Office, Cincinnati, Ohio

A statement of low-water conditions on Kentucky River during the current season follows:

I think there is little doubt that the drought of this year has been the worst on record. Early in the summer old citizens of central Kentucky began comparing it with the drought of 1855. For the three months, July to September, inclusive, the rainfall was only 3.23 inches, being 7.27 inches below normal. October and November rainfall was below normal, but data are not yet available.

The effect on navigation has been to lower pools below crests of dams. The pool above Dam No. 8 fell 4 feet below crest of dam. All of the pools above Dam No. 8 have dropped more or less below dam crests. Below Dam No. 8 the pools have been kept full by leakage and operating water discharged from Dix River Dam. However, for the past several months, most of the water from Dix Dam has been leakage since the reservoir had been drawn down 50 feet below normal and the Dix River power plant has been operated very